## About this Lesson

### *A. General Citation*

This lesson explores the use of National Landmark Sites located in Hampton, VA and Houston, TX. Information about the Lunar Landing Research Facility and Space Environment Simulation Laboratory was found primarily in NASA documents.

### *B. Where it fits into the curriculum*

This lesson is appropriate for students studying space exploration and technological innovations in 20th century American history or by science classes studying multidisciplinary units.
Time Period: 1960's
Standards Addressed:
United States History Standards for grades K-12:
Era 9: Postwar United States (1945 to early 1970s)

- Standard 1C- The student understands how postwar science augmented the nation's economic strength, transformed daily life, and influenced the world economy.

Curriculum Standards for Social Studies:
VIII Science, Technology, and Society

This lesson also covers the following Virginia Standards of Learning:

**Fourth Grade Science**

SOL 4.1 The student will plan and conduct investigations in which

a) distinctions are made among observations, conclusions, inferences, and predictions;
b) hypotheses are formulated based on cause-and-effect relationships;
c) variables that must be held constant in an experimental situation are defined;
e) appropriate metric measures are used to collect, record, and report data;

SOL 4.7 The student will investigate and understand the relationships among the Earth, moon, and sun.

d) historical contributions in understanding the Earth-moon-sun system

**Sixth Grade Science**

SOL 6.1 The student will plan and conduct investigations in which

c) precise and approximate measurements are recorded;
d) scale models are used to estimate distance, volume, and quantity;
e) hypotheses are stated in ways that identify the independent (manipulated) and dependent (responding) variables;
f) a method is devised to test the validity of predictions and inferences;
g) one variable is manipulated over time, using many repeated trials;
h) data are collected, recorded, analyzed, and reported using appropriate metric measurements;
i) data are organized and communicated through graphical representation (graphs, charts, and diagrams);
j) models are designed to explain a sequence; and

k) an understanding of the nature of science is developed and reinforced.

SOL 6.8 The student will investigate and understand the organization of the solar system and the relationships among the various bodies that comprise it. Key concepts include:

a) the sun, moon, Earth, other planets and their moons, meteors, asteroids, and comets;
c) the role of gravity;
i) the history and technology of space exploration

**Sixth Grade Social Studies**

SOL USI.2 The student will use maps, globes, photographs, pictures, and tables to

b) locate and describe the location of the geographic regions of North America: Coastal Plain, Appalachian Mountains, Canadian Shield, Interior Lowlands, Great Plains, Rocky Mountains, Basin and Range, and Coastal Range.

Essential Knowledge- geographic regions- locations and physical characteristics (Why did astronauts train in certain places? Why did they take geology fieldtrips to certain areas?)

**Visual Arts**

Fifth Grade
5.17 The student will compare contemporary and historical art and architecture

Eighth Grade
8.13 The student will identify and analyze art and architecture from various world cultures, periods, or civilizations by styles, symbolism, and technological impact.

***C. Objectives for students***

1) To examine the training necessary to send astronauts to the moon.
2) To describe cooperation between NASA and military installations across the country when training astronauts.
3) To explain why Earth's geological features are similar to the features of the moon.
4) To compare training in the 1960's and 1970's to training for a moon mission today and identify locations or assets in their community that could be used to train astronauts.

***D. Materials for students***

1) Computer with internet access
2) Online GIS maps of the United States, NASA Langley Research Center, and NASA's Johnson Space Center.
3) Readings from site descriptions.
4) Readings in lesson plan and photograph in lesson plan.
5) Colored Pencils

6) Writing implement such as a pencil.
7) Student Worksheet.
8) Paper for drawing.

***E. Visiting the sites***

**NASA Langley Research Center** (www.vasc.org)
The Virginia Air and Space Center is the official visitors' center for NASA Langley Research Center. It is located in downtown Hampton, VA, on the main street, Settlers Landing Road.

**Johnson Space Center** (http://www.spacecenter.org/)
The official visitors' center for Johnson Space Center is Space Center Houston. Space Center Houston is located at 1601 NASA Parkway, Houston, TX 77058, in the Clear Lake area.

III. Teaching Activities

A. Getting Started
- Begin with showing students. Ask students "What do you think is happening in this photo?" Let students brainstorm as a class and record their ideas. This photo will be seen during the lesson at the Lunar Landing Facility site, and students will be able to see what was happening.

B. Setting the Stage
- Using the student worksheet, ask students to read the following passage. This serves as an introduction to the activity. After reading and discussing the passage, ask students "What training would you want to have before you went to the moon? What kinds of challenges do you think you will encounter?"

If you were going to the moon, what would you do before you left Earth? The Apollo astronauts spent a year and a half preparing for lift-off. Much of the astronaut training occurred at the newly constructed Johnson Space Center, a NASA facility built to house the Space Task Group (STG), which later became the Manned Spacecraft Center (MSC). Other NASA centers, and military bases had specialized training equipment and simulators, and the astronauts would travel to these centers to complement the training they underwent at Johnson Space Center.

Simulators that mimicked the extreme environments of space and the moon were designed, such as the Space Environment Simulation Laboratory at Johnson Space Center. Other simulators, such as the Lunar Landing Research Facility at NASA's Langley Research Center, were designed to simulate the lessened gravitational force of the moon. Other simulators taught the astronauts how to

pilot and control their space modules. The intense training and preparation the astronauts underwent helped avert potential disasters during space missions.

C. Locating the Site
See online GIS maps. US Map, Langley Research Center Map, Johnson Space Center Map. Students can use these maps to answer the student worksheet questions. (http://gis.larc.nasa.gov/past_missions/edu_intro/page1.html Click Students to access maps.)

*Note- there are multiple training sites in Houston, TX and students will need to click the menu button at the top of the page that reads "Houston, TX" in order to see all of the sites.

D. Putting it all together. These activities are designed to be completed after students have finished the student worksheet. The worksheet could be assigned as homework and the activities could be completed the following day in class. The student worksheet can be found in the Teacher section of the site and includes questions about Mercury and Apollo astronaut training.

- Activity 1: Training Today's Astronauts
    i. Create groups of 4-5 students, and challenge them to come up with a new training plan for astronauts traveling to the moon today. Ask students how training today would be different from Apollo training in the 1960's and 1970's? Ask students to think of ways astronauts could train in their community using existing natural and man-made resources?
- Activity 2: Earth Rocks!
    i. Ask students why astronauts took geological field trips and learned about Earth's geological formation when they were going to travel to the moon. Ask students to identify the geographic provinces the astronauts visited during their field trips, and why these areas were chosen. Compare and contrast the composition of moon rocks and Earth rocks. Ask students to read the articles found at http://aerospacescholars.jsc.nasa.gov/HAS/cirr/em/6/6.cfm or http://science.nasa.gov/headlines/y2006/05may_moonrocks.htm to help compare and contrast how moon and Earth rocks are used.
- Activity 3: Practicing weightlessness
    i. Have students compare the Sonny Carter Neutral Buoyancy Center (http://dx12.jsc.nasa.gov/site/index.shtml) to the Water Facility Tank in building 29 at Johnson Space Center. Have students compare not only the sizes of the two training facilities, but also the size of today's shuttle to the Apollo space modules.
    ii. To help students understand the sheer magnitude of the new facility, ask students to solve the following problems.

1. What is the volume of the pool in the Sonny Carter Neutral Buoyancy Center in cubic meters? (Dimensions are available at http://dx12.jsc.nasa.gov/site/index.shtml.)
2. What is the volume of an Olympic size swimming pool? (Assume dimensions of 50m x 25 m x 3m)
3. How much larger is the volume of the Sonny Carter Neutral Buoyancy Center than the swimming pool in part 2? (Hint: Divide the volume of the Sonny Carter Neutral Buoyancy Center by the swimming pool volume)

- Activity 4: What, no air?
  i. Since the moon lacks an atmosphere, many of the activities we enjoy on Earth are impossible to enjoy on the moon. Use this activity to help students understand limitations of living on the moon.
  ii. Ask students to pretend they have moved to a new space colony on the moon. Tell your students they enjoyed parachuting on Earth and have decided to build a plane so you can parachute on the moon. Have students answer the following two questions and complete the activity.
    1. How do you think the decent to the moon will feel? Would it feel different from jumping out of a plane flying above Earth? If so, why? (This question relates to the lessened gravitational force on the moon.)
    2. Can you think of any reasons you might not want to use a parachute to slow your decent? (This question relates to the lack of an atmosphere on the moon.)
    3. Draw a picture showing what might happen to a parachute after it is opened over the moon.

E. Supplementary Resources

- The NASA website offers much information about the history of the space program and information about current space missions. (www.nasa.gov)
- The Langley Research Center and Johnson Space Center websites which contain historical information, educational content, and current missions. (http://www.nasa.gov/centers/langley/home/index.html and http://www.nasa.gov/centers/johnson/home/index.html)
- Langley Research Center and Johnson Space Center each have visitor's centers open to the public. The centers showcase past and present NASA missions, and each center highlights current research currently underway at its host center. (www.vasc.org and http://www.spacecenter.org)
- The Morehead Planetarium and Science Center, part of the National Park Service Chapel Hill Historic District, exhibits photographs and equipment used while training Mercury, Gemini, and Apollo Astronauts. Visitors are welcome and their webpage provides more information about training during the Space Race. (http://www.moreheadplanetarium.org/index.cfm Historical information located at

http://www.moreheadplanetarium.org/index.cfm?fuseaction=page&filename=history3.html)

- The NASA History Series publications document advances in NASA history. Many publications are available online. (http://history.nasa.gov/series95.html)